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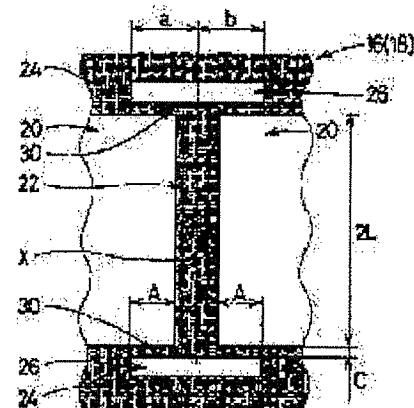
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(54) ELECTRODE FORMING METHOD OF ELECTRONIC PARTS AND ELECTRODE FORMING DEVICE USED FOR THE SAME

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an electrode forming method of electronic parts which have the extremely few electrode pattern defects occurring in thermal deformation and are less degraded in strength, and an electrode forming device.

SOLUTION: This electrode forming device for the electronic parts includes a film forming pattern mask 16 having film forming holes 20 and masking parts 22. This film forming pattern mask 16 is provided with relief holes 26 of, for example, a rectangular shape on both sides in the longitudinal direction of the masking parts 22, by which flexible parts 30 like, for example, fixed beams, fixed at their both ends as fixing ends are formed between the masking parts 22 and these relief holes 26. The thermal stresses in the masking parts 22 occurring in the temp. difference between the masking parts 22 and their peripheral parts at the time of the film forming treatment are absorbed by the flexible parts 30 which deflect toward the relieve holes 26.



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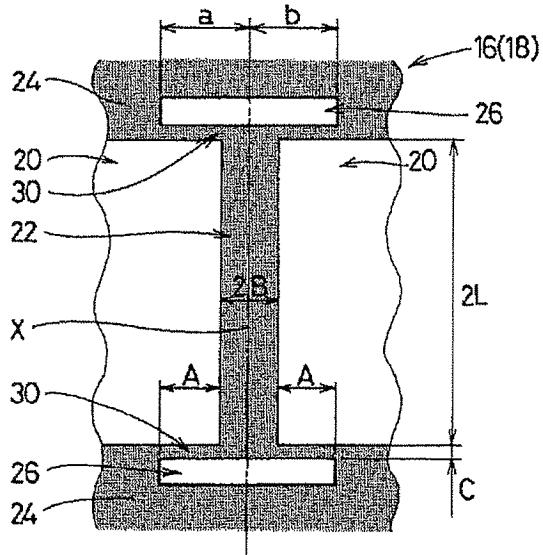
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(54)【発明の名称】電子部品の電極形成方法およびそれに用いる電極形成装置

(57)【要約】

【課題】熱変形に起因する電極パターン不良が極めて少なく、かつ、強度低下の少ない電子部品の電極形成方法および電極形成装置を提供する。

【解決手段】この電子部品の電極形成装置10は、成膜孔20およびマスキング部22を有する成膜パターンマスク16を含む。成膜パターンマスク16には、マスキング部22の長さ方向の両側に、たとえば矩形の逃がし孔26を設けることにより、マスキング部22と逃がし孔26との間に、その両端部が固定され固定端とされた、所謂、固定ばかり状の可撓部30が形成される。成膜処理時のマスキング部22とその周辺部との温度差に起因するマスキング部22内の熱応力は、可撓部30が逃がし孔26方向に撓むことによって吸収される。



【特許請求の範囲】

【請求項1】 マスクを用いてワークに電極となる材料を付着させる電子部品の電極形成方法であって、ワークを準備する工程、前記ワークの主面上に前記マスクを配置する工程、および前記マスクの主面側から電極となる電極材料を付与する工程を含み、前記マスクは、前記材料を前記ワークに付着させるために配設された複数の成膜孔、前記ワークの所定の部分に接触し、前記ワークの所定の部分を遮蔽するマスキング部、および前記成膜孔の近傍で隣合う前記成膜孔間を跨るように両端が固定されて配設され、前記マスキング部の熱変形を吸収する固定ばり状の可撓部を含む、電子部品の電極形成方法。

【請求項2】 前記可撓部は、前記成膜孔の近傍に逃がし孔を設けることによって構成される、請求項1に記載

の電子部品の電極形成方法。

【請求項3】 前記可撓部は、前記成膜孔の近傍に切欠き部を設けることによって構成される、請求項1に記載の電子部品の電極形成方法。

【請求項4】 前記可撓部は、隣合う前記成膜孔間の前記マスキング部の中心線に対して対称に配設される、請求項1ないし請求項3のいずれかに記載の電子部品の電極形成方法。

【請求項5】 前記可撓部は、前記マスキング部の両側に配置され、

前記可撓部の長さをA (mm)、前記可撓部の幅をC (mm)、前記マスキング部の全長を2L (mm)、前記マスキング部の幅を2B (mm)、前記マスキング部の最高温度と前記マスキング部の周辺部の温度との温度差を ΔT (°C)、前記マスクの厚みをh (mm)、前記マスクの材料の熱膨張係数を α (1/°C) とすると、

$$12L^3C^3 \alpha \Delta T$$

$$3 \geq$$

$$\pi^2 h^2 \{LC^3 (1 + \alpha \Delta T) + A^3 B\}$$

を満足する、請求項1ないし請求項4のいずれかに記載の電子部品の電極形成方法。

【請求項6】 前記可撓部は、前記マスキング部の片端に配置され、可撓部の長さをA (mm)、前記可撓部の幅をC (m

m)、前記マスキング部の全長を2L (mm)、前記マスキング部の幅を2B (mm)、前記マスキング部の最高温度と前記マスキング部の周辺の温度との温度差を ΔT (°C)、前記マスクの厚みをh (mm)、前記マスクの材料の熱膨張係数を α (1/°C) とすると、

$$24L^3C^3 \alpha \Delta T$$

$$3 \geq$$

$$\pi^2 h^2 \{2LC^3 (1 + \alpha \Delta T) + A^3 B\}$$

を満足する、請求項1ないし請求項4のいずれかに記載の電子部品の電極形成方法。

【請求項7】 マスクを用いてワークに電極となる材料を付着させる電子部品の電極形成装置であって、前記マスクは、前記材料を前記ワークに付着させるために配設された複数の成膜孔、

前記ワークの所定の部分に接触し、前記ワークの所定の部分を遮蔽するマスキング部、および前記成膜孔の近傍で隣合う前記成膜孔間を跨るように両端が固定されて配設され、前記マスキング部の熱変形を吸収する固定ばり状の可撓部を含む、電子部品の電極形成装置。

【請求項8】 前記可撓部は、前記成膜孔の近傍に逃がし孔を設けることによって構成される、請求項7に記載の電子部品の電極形成装置。

$$12L^3C^3 \alpha \Delta T$$

$$3 \geq$$

$$\pi^2 h^2 \{LC^3 (1 + \alpha \Delta T) + A^3 B\}$$

を満足する、請求項7ないし請求項10のいずれかに記載の電子部品の電極形成装置。

【請求項12】 前記可撓部は、前記マスキング部の片側に配置され、

前記可撓部の長さをA (mm)、前記可撓部の幅をC (mm)、前記マスキング部の全長を2L (mm)、前記マスキング部の幅を2B (mm)、前記マスキング部の最高温度と前記マスキング部の周辺部の温度との温度差を ΔT (°C)、前記マスクの厚みをh (mm)、前記マスクの材料の熱膨張係数を α (1/°C) とすると、

差を ΔT (°C)、前記マスクの厚みを h (mm)、前記

$$24L^3C^3 \alpha \Delta T$$

$$3 \geq$$

$$\pi^2 h^2 \{2LC^3 (1 + \alpha \Delta T) + A^3 B\}$$

を満足する、請求項7ないし請求項10のいずれかに記載の電子部品の電極形成装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】この発明は、電子部品の電極形成方法およびそれに用いる電極形成装置に関し、特に、基板に電極が形成される、たとえば発振子、共振子などの電子部品の電極形成方法およびそれに用いる電極形成装置に関する。

【0002】

【従来の技術】図9は、この発明の背景となる従来の蒸着用マスクの一例を示す平面図である。この蒸着用マスク1は、たとえば矩形の金属平板2を含む。金属平板2には、所定の位置に複数の開口部3が設けられている。これらの開口部3, ..., 3は、第1のマスキング部としての機能を有する複数の仕切部1bにより仕切られ、それらの仕切り部1bは第2のマスキング部としての機能を有する周辺部1aへと接続される。

【0003】このような蒸着用マスク1では、開口部3を仕切る仕切部1bはその幅が細いため、蒸着時の熱伝導による放熱量が小さい。また、通常、周辺部1aは、この蒸着用マスク1を搭載するための保持部となるので、その保持部分から熱が放出される。そのため、仕切部1bの温度が周辺部1aの温度よりも高くなり、仕切部1bの熱膨張量が周辺部1aの熱膨張量よりも大きくなる。しかも、仕切部1bの剛性は、周辺部1aの剛性よりも小さいので、仕切部1bが熱変形し、仕切部1bとたとえば基板として形成されるワーカとの間に隙間が生じる。そのため、その隙間に電極膜となる電極材料が入り込む。この場合、電極パターンの一部に不良部分、所謂、電極パターン不良（俗称：ボケ）が発生してしまう。

【0004】そこで、この電極パターン不良を緩和するために、言い換えると、仕切部1bとその周辺部1aとの温度差に起因する仕切部1bの熱変形を緩和するために、たとえば図10に示すように、周辺部1aの周囲に切込み4を設けた蒸着用マスク1が提案されている。この蒸着用マスクは、この発明の背景となり、特開昭61-130480号に開示されている。この蒸着用マスク1は、図9の従来例と比べて、特に、複数の切込み4が、開口部3から金属平板2の端部に至り、かつ、金属平板2のほぼ中心を通る直線に沿うように設けられている。図10に示す蒸着用マスク1では、蒸着時において、仕切部1bと周辺部1aとの熱膨張量の差が切込み4によって吸収されるため、図9に示す蒸着用マスク1に比べて、電極パターン不良をある程度小さくすること

マスクの材料の熱膨張係数を α (1/°C) とすると、

ができる。

【0005】図11および図12は、実開昭63-73350号に開示され、さらにこの発明の背景となる従来のスパッタリングマスクの一例を示す平面図である。図12のスパッタリングマスク1は、たとえば矩形棒状のマスク棒5を含む。マスク棒5の中央には、複数の矩形のスパッタ孔6a, ..., 6aを有する円形状のマスク部6が配置される。マスク部6は、マスク棒5の各辺5a, 5b, 5cおよび5dの中央からマスク部6へと延びてマスク部6と連結する支え部7a, 7b, 7cおよび7dによって支持されている。支え部7a~7dには、たとえば半円状の切欠き部からなる逃がし溝8a~8dが形成されている。また、マスク棒5には、マスク棒5の各辺5a~5dと支え部7a~7dとマスク部6との協動作により、4つのダミー孔9が設けられている。一方、図12のスパッタリングマスク1は、図11のスパッタリングマスク1に比べて、マスク部6が方形状に形成され、特に、マスク部6を支持する支え部に、逃がし溝8a~8dを設けていない支え部7e, 7f, 7gおよび7hがさらに配設されている。図11および図12に示すスパッタリングマスク1では、スパッタリング時において、マスク部6が熱膨張して拡がったときに、その膨張力を逃がし溝8a~8dによって吸収することができるため、電極パターン不良を小さくすることができます。

【0006】

【発明が解決しようとする課題】しかしながら、特開昭61-130480号に開示されている図10の蒸着用マスク1の構造では、蒸着時において、切込み4部分にも電極材料が入り込むため、所望する電極パターンを正確に得ることができない。また、蒸着時の熱膨張による圧縮応力が大きい場合、図10の2点鎖線で示すように、金属平板2の変形に伴い開口部3の形状が変形してしまうので、これまた、所望する電極パターンを正確に得ることができない。

【0007】一方、実開昭63-73350号に開示されている図11のスパッタリングマスク1では、マスク部6を支持する幅寸法の狭い支え部7a~7dに逃がし溝8a~8dが形成されているので、支え部7a~7dひいてはマスク部6の機械的強度が弱くなり、マスク部6を正確に支持することができない恐れがある。さらに、マスク自体の取扱いも困難なものとなる。

【0008】また、図12のスパッタリングマスク1では、逃がし溝のない支え部7e~7hがあるため、スパッタリング時の熱膨張による圧縮応力を吸収するという効果を達成できない。したがって、実開昭63-733

50号に開示されている図12のスパッタリングマスク1でも、所望する電極パターンを正確に得ることができない。

【0009】それゆえに、この発明の主たる目的は、熱変形に起因する電極パターン不良が極めて少なく、かつ、強度低下の少ない電子部品の電極形成方法およびそれに用いる電極形成装置を提供することである。

【0010】

【課題を解決するための手段】請求項1に記載の発明は、マスクを用いてワークに電極となる材料を付着させる電子部品の電極形成方法であって、ワークを準備する工程と、ワークの主面上にマスクを配置する工程と、マスクの正面側から電極となる電極材料を付与する工程とを含み、マスクは、材料をワークに付着させるために配設された複数の成膜孔と、ワークの所定の部分に接触し、前記ワークの所定の部分を遮蔽するマスキング部と、成膜孔の近傍で隣合う成膜孔間を跨るように両端が固定されて配設され、マスキング部の熱変形を吸収す

る固定ばり状の可撓部とを含む、電子部品の電極形成方法である。請求項2に記載の発明は、可撓部が成膜孔の近傍に逃がし孔を設けることによって構成される、請求項1に記載の電子部品の電極形成方法である。請求項3に記載の発明は、可撓部が成膜孔の近傍に切欠き部を設けることによって構成される、請求項1に記載の電子部品の電極形成方法である。請求項4に記載の発明は、可撓部が隣合う成膜孔間のマスキング部の中心線に対して対称に配設される、請求項1ないし請求項3のいずれかに記載の電子部品の電極形成方法である。請求項5に記載の発明は、可撓部がマスキング部の両側に配置され、可撓部の長さをA (mm)、可撓部の幅をC (mm)、マスキング部の全長を2L (mm)、マスキング部の幅を2B (mm)、マスキング部の最高温度とマスキング部の周辺部の温度との温度差を ΔT (°C)、マスクの厚みをh (mm)、マスクの材料の熱膨張係数を α (1/°C) とすると、

$$12L^3C^3 \alpha \Delta T$$

$3 \geq$

$$\pi^2 h^2 \{LC^3 (1 + \alpha \Delta T) + A^3 B\}$$

(mm)、マスキング部の最高温度とマスキング部の周辺の温度との温度差を ΔT (°C)、マスクの厚みをh (mm)、マスクの材料の熱膨張係数を α (1/°C) とすると、

$$24L^3C^3 \alpha \Delta T$$

$3 \geq$

$$\pi^2 h^2 \{2LC^3 (1 + \alpha \Delta T) + A^3 B\}$$

を満足する、請求項1ないし請求項4のいずれかに記載の電子部品の電極形成方法である。請求項7に記載の発明は、マスクを用いてワークに電極となる材料を付着させる電子部品の電極形成装置であって、マスクは、材料をワークに付着させるために配設された複数の成膜孔と、ワークの所定の部分に接触し、前記ワークの所定の部分を遮蔽するマスキング部と、成膜孔の近傍で隣合う成膜孔間を跨るように両端が固定されて配設され、マスキング部の熱変形を吸収する固定ばり状の可撓部とを含む、電子部品の電極形成装置である。請求項8に記載の発明は、可撓部が成膜孔の近傍に逃がし孔を設けることによって構成される、請求項7に記載の電子部品の電極形成装置である。請求項9に記載の発明は、可撓部が

成膜孔の近傍に切欠き部を設けることによって構成される、請求項7に記載の電子部品の電極形成装置である。請求項10に記載の発明は、可撓部が隣合う成膜孔間のマスキング部の中心線に対して対称に配設される、請求項7ないし請求項9のいずれかに記載の電子部品の電極形成装置である。請求項11に記載の発明は、可撓部がマスキング部の両側に配置され、可撓部の長さをA (mm)、可撓部の幅をC (mm)、マスキング部の全長を2L (mm)、マスキング部の幅を2B (mm)、マスキング部の最高温度とマスキング部の周辺部の温度との温度差を ΔT (°C)、マスクの厚みをh (mm)、マスクの材料の熱膨張係数を α (1/°C) とすると、

$$12L^3C^3 \alpha \Delta T$$

$3 \geq$

$$\pi^2 h^2 \{LC^3 (1 + \alpha \Delta T) + A^3 B\}$$

を満足する、請求項7ないし請求項10のいずれかに記載の電子部品の電極形成装置である。請求項12に記載の発明は、可撓部がマスキング部の片側に配置され、可撓部の長さをA (mm)、可撓部の幅をC (mm)、マスキング部の全長を2L (mm)、マスキング部の幅を

2B (mm)、マスキング部の最高温度とマスキング部の周辺部の温度との温度差を ΔT (°C)、マスクの厚みをh (mm)、マスクの材料の熱膨張係数を α (1/°C) とすると、

$24L^3C^3 \alpha \Delta T$

3 ≥

$$\pi^2 h^2 \{2LC^3 (1 + \alpha \Delta T) + A^3 B\}$$

を満足する、請求項7ないし請求項10のいずれかに記載の電子部品の電極形成装置である。

【0011】

【作用】請求項1～請求項12に記載の発明において、マスキング部とその周辺部との温度差に起因するマスキング部内の熱応力、すなわち、熱膨張が拘束されることによる圧縮応力によって生じる熱変形は、可撓部が撓むことによって吸収され緩和される。特に、請求項2および請求項8に記載の発明では、逃げ孔方向に可撓部が撓むことによって、マスキング部の熱変形が吸収される。また、請求項3および請求項9に記載の発明では、切欠き部方向に可撓部が撓むことによって、マスキング部の熱変形が吸収される。また、請求項5および請求項11に記載の発明では、マスキング部の両側に可撓部が配置され、請求項5および請求項11で示された式を満足することにより、マスキング部の熱変形がさらに良くなる。さらに、請求項6および請求項12に記載の発明では、マスキング部の片側に可撓部が配置され、請求項6および請求項12で示された式を満足することにより、マスキング部の熱変形がさらに良くなる。

【0012】

【発明の効果】請求項1～請求項12に記載の発明によれば、上記作用により、マスキング部のワーク正面に垂直な方向の変形である座屈を緩和し、マスキング部とマスキング部により遮蔽されるワークの所定の部分との密着が損なわれない。したがって、電極パターンの端部に滲みのない正確な電極パターンをワークに形成することができる。さらに、請求項1～請求項12に記載の発明によれば、従来例に示すように、マスク自体の強度が極端に低くなることもない。すなわち、この発明によれば、熱変形に起因する電極パターン不良が極めて少なく、かつ、強度低下の少ない電子部品の電極形成方法およびそれに用いる電極形成装置が得られる。

【0013】この発明の上述の目的、その他の目的、特徴および利点は、図面を参照して行う以下の発明の実施の形態の詳細な説明から一層明らかとなろう。

【0014】

【発明の実施の形態】

【実施例】図1はこの発明の一実施例を示す斜視図であり、図2はその分解斜視図であり、図3はその一部を切り出した要部平面図である。この実施例の説明では、まず、この発明の電子部品の電極形成装置について説明する。この電子部品の電極形成装置10は、たとえば矩形板状のワークホルダー12を含む。ワークホルダー12は、たとえば矩形の複数の保持穴14, 14, ..., 14を有する。これらの保持穴14は、ワークW, W, ..., Wを保持するためのものであり、ワークホルダ

ー12の一方正面から他方正面に貫通して設けられる。複数の保持穴14は、ワークホルダー12の縦横に所定の間隔を隔てて設けられているが、図1および図2中では、中間部に配設される複数の保持穴14, ..., 14の図示は省略している。

【0015】ワークホルダー12の一方正面側および他方正面側には、それぞれ、マスクとして、たとえば矩形板状の成膜パターンマスク16および18が配設される。成膜パターンマスク16および18は同じ構造を有するので、一方の成膜パターンマスク16について説明する。成膜パターンマスク16は、たとえば短冊形の複数の成膜孔20, 20, ..., 20を有する。これらの成膜孔20は、ワークW, W, ..., Wの一方正面に所定の成膜パターンを形成するためのものであり、成膜パターンマスク16の一方正面から他方正面に貫通して設けられる。この実施例では、たとえば横並びに配置される2つ1組の成膜孔20, 20が、成膜パターンマスク16の長さ方向に延びて設けられる。2つ1組の成膜孔20, 20は、成膜パターンマスク16の縦横に所定の間隔を隔てて、複数組設けられている。複数の成膜孔20は、成膜パターンマスク16の縦横に所定の間隔を隔てて設けられているが、図1および図2中では、中間部に配設される複数の成膜孔20, ..., 20の図示は省略している。

【0016】成膜パターンマスク16には、たとえば図3および図4に示すように、複数の成膜孔20, 20の周囲に第1のマスキング部22および第2のマスキング部24が形成される。この場合、各組の成膜孔20, 20の一方の成膜孔20の横方向の一端と横並びに隣合う他方の成膜孔20の横方向の一端との間に、第1のマスキング部22が形成される。また、各組の成膜孔20, 20の一方の成膜孔20の長さ方向の一端と縦並びに隣合う他方の成膜孔20の長さ方向の一端との間に、第2のマスキング部24が形成される。

【0017】この実施例では、第1のマスキング部22がメインのマスキング機能を有するマスキング部として構成され、第2のマスキング部24がサブのマスキング機能を有するマスキング部として構成されている。

【0018】さらに、成膜パターンマスク16には、第1のマスキング部22の近傍で、この場合、第1のマスキング部22の長さ方向の一端側および他端側に、それぞれ、1組の第1の逃がし孔26, 26が部分的に配設される。一方、他方の第1の逃がし孔26, 26は、それぞれ、横並びの成膜孔20, 20間を跨がるように配設される。この実施例では、特にたとえば図4に示すように、第1のマスキング部22の全長が、2L (mm) に形成され、その幅が2B (mm) に形成される。また、

逃がし孔26, 26は、それぞれ、第1のマスキング部22の横方向の一端および他端から、A (mm) の距離だけ、成膜孔20, 20の横方向に延びて突き出し設けられる。なお、この実施例では、第1のマスキング部22の厚みh (mm) が、成膜パターンマスク16および18の厚みと同じに形成され、その厚みh (mm) に対して、第1のマスキング部22の全長2L (mm) および幅2B (mm) の方が大きく形成されている。

【0019】この実施例では、第1のマスキング部22の長さ方向の両側に第1の逃がし孔26, 26が設けられるため、両側の逃がし孔26と第1のマスキング部22との間には、細長い矩形のその両端が固定されている、所謂、固定ばり状の可撓部30, 30が形成される。この場合、第1のマスキング部22の横方向の一端および他端から、A (mm) の距離だけ、成膜孔20, 20の横方向に延びて突き出し設けられた部分をそれぞれ可撓部30, 30の長さとすると、可撓部30, 30の長さはA (mm) に形成され、可撓部30, 30の幅はC (mm) に形成される。また、逃がし孔26, 26の全長は、[a+b] (mm) に形成される。この実施例では、第1のマスキング部22の中心軸をX、第1の逃がし孔26, 26の長さ方向の一端および他端から中心軸Xまでの距離をそれぞれa (mm) およびb (mm) としたとき、a=bに形成される。これを言い換えると、可撓部30, 30は、その長さが中心軸Xを中心にして、左右均等に形成されている。つまり、隣合う成膜孔20, 20間に第1のマスキング部22の幅方向の中心線に対して対称に配設されている。

【0020】さらに、成膜パターンマスク16には、第2のマスキング部24の近傍で、この場合、第2のマスキング部24の長さ方向の一端側および他端側に、1組の第2の逃がし孔28, 28が、それぞれ、部分的に配設される。一方、他方の第2の逃がし孔28, 28は、それぞれ、縦並びの成膜孔20, 20間に跨がるように配設される。

【0021】同様にして、ワークホルダー12の他方正面側には、成膜パターンマスク18が配設される。なお、この実施例では、ワークホルダー12、成膜パターンマスク16および18が、ほぼ同じ大きさに形成され、それぞれ、互いに対応する位置に位置決め孔(図示せず)が設けられている。

【0022】ワークホルダー12は、2つの成膜パターンマスク16および18の間に挟持された状態で、位置決めピンを有するマスクホルダー(図示せず)に装着される。この場合、成膜パターンマスク18、ワークホルダー12および成膜パターンマスク16が、順次、マスクホルダー(図示せず)の位置決めピンに嵌め込まれ、マスクホルダー(図示せず)に装着される。

【0023】次に、上述のワークホルダー12、成膜パターンマスク16および18を含む電子部品の電極形成

装置10を用いた電子部品の電極形成方法について説明する。まず、基板となる矩形板状の複数のワークWが準備される。これらのワークWには、圧電セラミックスなどが用いられる。また、ワークホルダー12、成膜パターンマスク16および18が準備される。

【0024】そして、複数のワークWは、ワークホルダー12の保持穴14に嵌め込まれて保持される。また、ワークホルダー12の表面側および裏面側には、成膜パターンマスク16および18が配置される。さらに、成膜パターンマスク16および18間にワークWを保持したワークホルダー12を挟持した状態で、それらの部材16, 12, 18がマスクホルダー(図示せず)に装着される。それによって、ワークWが所定の位置に位置決めされる。

【0025】それから、ワークホルダー12、成膜パターンマスク16および18をマスクホルダー(図示せず)にセットした状態で、たとえばスパッタリング、蒸着、その他の成膜方法によって、ワークWの表面および裏面に成膜処理が施される。そのため、ワークWの表面および裏面には、それぞれ、成膜パターンマスク16および18の成膜孔20を通して露出された部分に電極材料が付着する。また、ワークWの表面および裏面の電極不要部分は、成膜パターンマスク16および18の成膜孔20を除く部分、つまり、第1のマスキング部22および第2のマスキング部24によって遮蔽されるため、電極材料が付着しない。したがって、ワークWの表面および裏面には、それぞれ、電極となる所望の成膜パターンが形成される。

【0026】この実施例では、特に、成膜パターンマスク16, 18の第1のマスキング部22の長さ方向の両側に逃がし孔26, 26を配設することにより、第1のマスキング部22の長さ方向の両側に、その両端が固定され固定端となる、所謂、固定ばり状の可撓部30, 30が形成されているので、成膜処理時に発生する第1のマスキング部22内の熱応力、つまり、第1のマスキング部22とその周辺部との温度差に起因する第1のマスキング部22の熱変形を可撓部30, 30によって吸収し緩和することができる。この場合、第1のマスキング部22は、可撓部30, 30を介してその周辺部、つまり、第2のマスキング部24と接続されており、たとえば図5に示すように、可撓部30, 30が逃がし孔26, 26方向に撓むことによって、第1のマスキング部22の熱変形を吸収し緩和することができるという緩和効果が得られる。

【0027】そこで、上述の緩和効果について、本願発明の発明者が鋭意検討したところ、理論式およびFEMシミュレーションによって、可撓部30, 30の形状、材料などのパラメータと、第1のマスキング部22内に緩和しきれずに残留する圧縮応力 σ (kgf/mm²)との関係は、たとえば図4に示すように、第1のマスキ

ング部22の長さ方向の両側に固定ばかり状の可撓部30, 30を配設した場合で、上記可撓部30, 30の長さをA (mm)、上記第1のマスキング部22の幅を2B (mm)、上記可撓部30, 30の幅をC (mm)、上記第1のマスキング部22の長さを2L (mm)、上記第1のマスキング部22の最高温度と上記第1のマスキング部22の周辺部の温度との温度差を ΔT (°C)、

$$\sigma = \frac{E L C^3 \alpha \Delta T}{L C^3 (1 + \alpha \Delta T) + A^3 B} \cdots \text{[式1]}$$

【0029】一方、第1のマスキング部22の形状を長方形の断面をもつ長柱と見れば、この第1のマスキング部22が座屈をおこし変形を生じ始める圧縮応力 σ_k (kgf/mm²)は、オイラーの式より、次の【式2】となる。但し、この場合、第1のマスキング部22の長さ方向の両端は、固定端と仮定している。

【0030】

$$\sigma_k = \frac{\pi^2 E h^2}{12 L^2} \cdots \text{[式2]}$$

【0031】本願発明の発明者は、第1のマスキング部

$$\sigma = \frac{12 L^3 C^3 \alpha \Delta T}{\sigma_k \pi^2 h^2 \{ L C^3 (1 + \alpha \Delta T) + A^3 B \}} \cdots \text{[式3]}$$

【0033】そこで、 σ/σ_k の比と電極パターン不良（俗称：ボケ）の有無との関係を以下の実験例によって、調査した。

【実験例】この実験例では、成膜パターンマスク16 (18) の厚み $h = 0.3$ (mm) とし、さらに、たとえば図4において、 $L = 14.7$ (mm)、 $C = 0.3$ (mm)、 $\alpha = 18 \times 10^{-6}$ (1/°C) (材料: SUS 304相当)、 $\Delta T = 180$ °C (実測値) とし、さらに、AおよびBの寸法を適当に設定して、成膜パターンマスクを試作した。そして、その成膜パターンマスクを用いて、ワークWに成膜処理を施した。その実験結果を図6のグラフに示す。図6中の実線および破線は、上記可撓部30, 30の長さA (mm) をパラメータとして、上記【式3】の計算結果を表したものである。この場合、NG-dataのプロット点は、電極パターン不良（俗称：ボケ）が発生したことを示し、G-dataのプロット点は、電極パターン不良（俗称：ボケ）が発生していないことを示している。

【0034】図6の実験結果から明らかに、 $3.0 \geq \sigma/\sigma_k$ の関係を満足する場合、電極パターン不良（俗称：ボケ）が発生していないことが実証された。この場合、上記【式3】の値が3.0以下になるように、第1のマスキング部22、逃がし孔26, 26および可撓部30, 30を有する成膜パターンマスク16, 18の形状および材料を設計すれば、成膜処理時の電極パターン不良（俗称：ボケ）を防止することができる。す

上記第1のマスキング部22の厚みを h (mm)、上記第1のマスキング部22の材料の熱膨張係数を α (1/°C)、上記第1のマスキング部22の綫弾性係数をE (kgf/mm²) とすると、概ね、次の【式1】で表せることができた。

【0028】

22内に緩和しきれずに残留する圧縮応力 σ (kgf/mm²) と第1のマスキング部22が座屈をおこし変形を生じ始める圧縮応力 σ_k (kgf/mm²) との比、つまり、 σ/σ_k が、電極パターン不良（俗称：ボケ）の有無を決定すると想定した。すなわち、 σ/σ_k は次の【式3】になると想定した。

【0032】

なわち、上記【式3】を満足する成膜パターンマスクを用いれば、成膜処理時の第1のマスキング部22とその周辺部との温度差に起因する第1のマスキング部22の熱変形は、可撓部30, 30が逃がし孔26, 26方向に撓むことによって、第1のマスキング部22の熱変形を吸収し緩和できる。

【0035】したがって、この実施例では、ワークWと、成膜パターンマスク16, 18の成膜孔20を除く部分、特に、第1のマスキング部22との間に隙間が発生することを防止できる。そのため、この実施例では、ワークWと前記隙間との間に電極材料が入り込むことによって生じる電極パターン不良（俗称：ボケ）を防止することができる。すなわち、上述の実施例では、ワークWに正確に電極パターンを形成することができ、パターンエッジも鮮明となる。それゆえ、この実施例の電極形成装置を用いた電極形成方法により形成された電極を有する基板を用いれば、電気的特性が安定で信頼性に富んだ電子部品を作製することができる。

【0036】上述の実施例では、第1のマスキング部22の長さ方向の両側に可撓部30, 30を配設したが、第1のマスキング部22の長さ方向の片側にだけ可撓部30を配設した場合、上記【式1】の l を $2L$ とすればよいため、 σ/σ_k は次の【式4】になると想定される。

【0037】

$$\frac{\sigma}{\sigma_k} = \frac{\pi^2 h^2 (2LC^2 (1 + \alpha \Delta T) + A^2 B)}{24L^3 C^3 \alpha \Delta T} \quad \dots \quad [\text{式4}]$$

【0038】この場合においても、第1のマスキング部22の熱変形を吸収し緩和するためには、 $3.0 \geq \sigma / \sigma_k$ の関係を満足することが好ましい。

【0039】図7はこの発明の他の実施例を示す要部平面図である。この実施例は、図1～図4等に示す実施例と比べて、特に、第1のマスキング部の幅が一様でない。すなわち、図7に示す実施例では、図4などに示す第1のマスキング部22と比べて、第1のマスキング部32の長さ方向の中間部に、たとえば矩形の突出部34、34が形成され、第1のマスキング部32の幅寸法が一定していない。この場合、第1のマスキング部32の幅の最も小さい部分の寸法をマスキング部の幅2B (mm) に設定することにより上記【式3】の応力計算を行い、より安全に成膜パターンマスクを設計すればよい。

【0040】図8はこの発明のさらに他の実施例を示す要部平面図である。この実施例は、図1～図4等に示す実施例と比べて、特に、複数の第1のマスキング部が隣接して形成されている。すなわち、図8に示す実施例では、図4などに示す単独で配設された第1のマスキング部22と比べて、たとえば2つの第1のマスキング部36aおよび36bが、他の第1の逃がし孔38を介して、横方向に隣接して配設されている。そのため、図8に示す実施例では、2つの第1のマスキング部36aおよび36bの長さ方向の両側に、それぞれ、単独の可撓部30を形成することができない。したがって、図8に示す実施例では、2つの第1のマスキング部36aおよび36bの長さ方向の両側において、それぞれ、1つの可撓部30を共用する構成となっている。この場合、第1のマスキング部36aおよび36bのマスキング幅の寸法 (mm) は、 $2B - 2B_0$ として設定され、上記【式3】の応力計算が行われる。なお、図8に示す実施例では、マスキング部が2つの第1のマスキング部36aおよび36bで形成されたが、たとえば3つ以上に形成された場合でも、同様の方法でマスキング部の幅寸法を設定し、上記【式3】の応力計算を行うことにより、成膜パターンマスクを設計すればよい。

【0041】なお、上述の各実施例では、成膜孔の近傍に逃がし孔を配設することによって可撓部を形成したが、たとえば図3および図4の第1の逃がし孔26および第2の逃がし孔28に変えて、たとえば成膜パターンマスク16 (18) の長さ方向および幅方向の一端から成膜孔20、20の近傍にかけて、切れき部を配設することによって、可撓部をそれぞれ形成するようにしてもよい。また、上述の各実施例では、成膜パターンマスク16および18に設けられた成膜孔20が矩形に形成されたが、それは単なる例示であって、成膜孔の形状は、

所望する電極パターンの形状に応じて、他の形状に任意に変更してもよい。また、ワークWの形状に応じて、ワークホルダー12の形状も、適宜、変更可能である。

【図面の簡単な説明】

【図1】この発明の一実施例を示す斜視図である。

【図2】この発明の一実施例を示す分解斜視図である。

【図3】この発明の一実施例を示す一部を欠いた要部平面図である。

【図4】この発明の一実施例を示す要部平面図である。

【図5】図1～図4の実施例における可撓部の作用を示す図解図であり、(A)は熱変形前の状態を示し、(B)熱変形時を示すものである。

【図6】電極パターン不良の発生の有無と応力比との関係を示すグラフである。

【図7】この発明の他の実施例を示す要部平面図である。

【図8】この発明のさらに他の実施例を示す要部平面図である。

【図9】この発明の背景となる従来の蒸着用マスクの一例を示す平面図である。

【図10】この発明の背景となる従来の蒸着用マスクの他の例を示す平面図である。

【図11】この発明の背景となる従来のスパッタリングマスクの一例を示す平面図である。

【図12】この発明の背景となる従来のスパッタリングマスクの他の例を示す平面図である。

【符号の説明】

10 電子部品の電極形成装置

12 ワークホルダー

14 保持穴

16, 18 成膜パターンマスク

20 成膜孔

22 第1のマスキング部

24 第2のマスキング部

26 第1の逃がし孔

28 第2の逃がし孔

30 可撓部

32 他の第1のマスキング部

34 突出部

36a, 36b さらに他の第1のマスキング部

38 他の第1の逃がし孔

A 可撓部の長さ (mm)

2B 第1のマスキング部の幅 (mm)

C 可撓部の幅 (mm)

2L 第1のマスキング部の全長 (mm)

h 第1のマスキング部の厚み (mm)

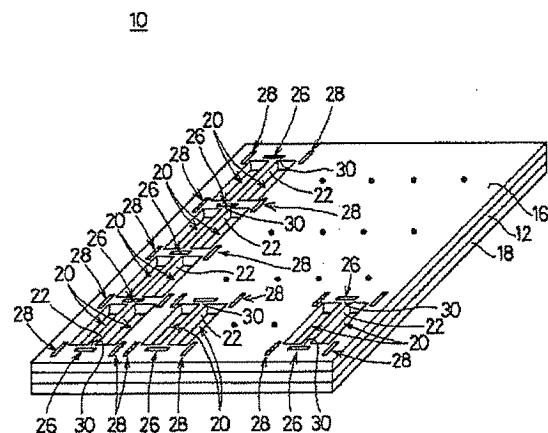
ΔT 成膜処理時における第1のマスキング部の最高温

度とその周辺部との温度差

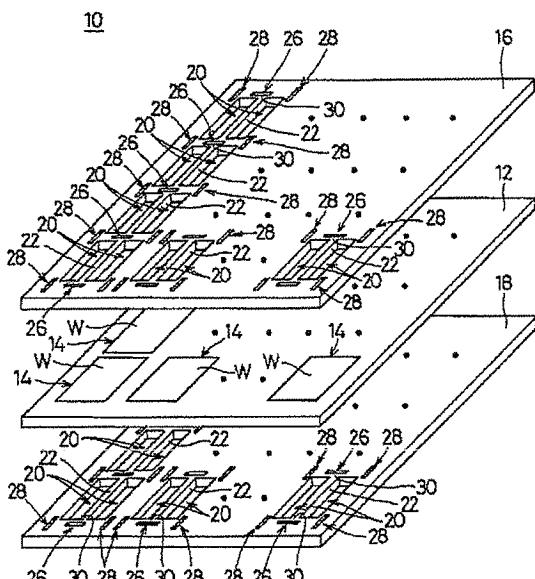
α 第1のマスキング部の熱膨張係数 (1/°C)
 E 第1のマスキング部の継弾性係数 (kgf/m²)

σ 第1のマスキング部22内に緩和しきれずに残留する圧縮応力 (kgf/mm²)
 σ_k 第1のマスキング部22が座屈をおこし変形を生じ始める圧縮応力 (kgf/mm²)

【图1】

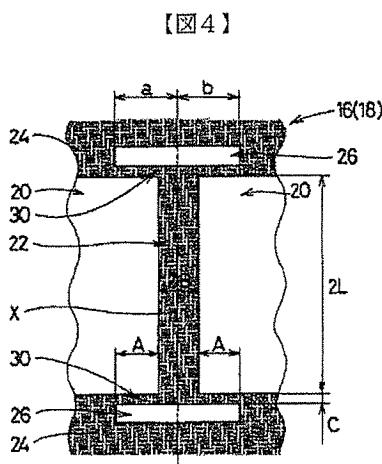


(图3)

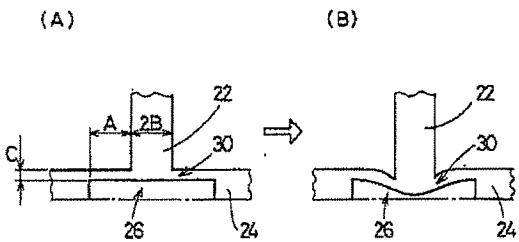


【図2】

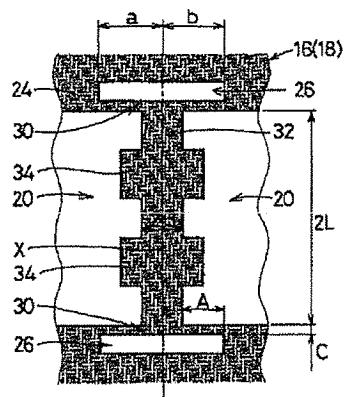
四八一



【図5】

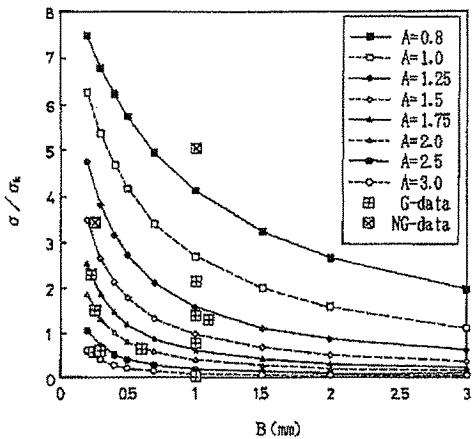


【図7】

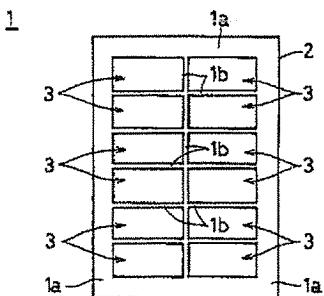


[图 101]

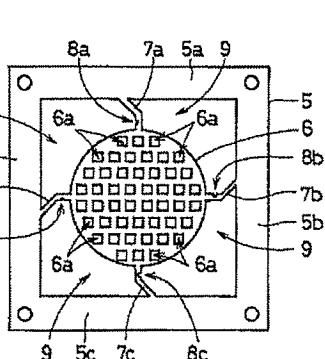
[図6]



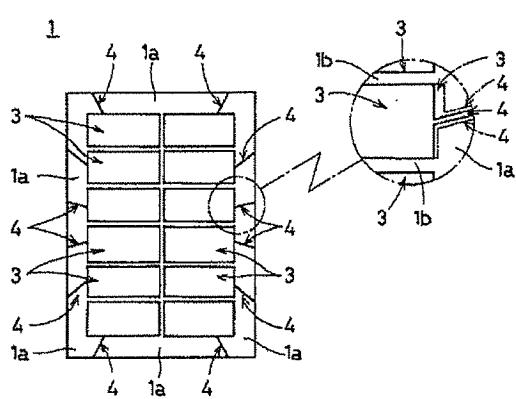
[图9]



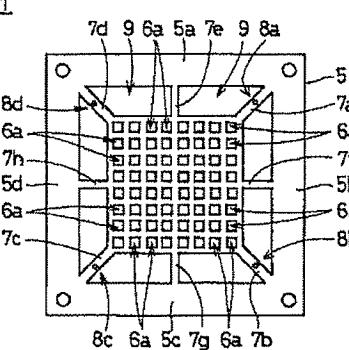
[図11]



〔图12〕



1



フロントページの続き

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CLAIMS

[Claim(s)]

[Claim 1] It is the electrode formation approach of electronic parts of making the ingredient used as an electrode adhering to a work piece using a mask. The process for which a work piece is prepared, the process which arranges said mask on the principal plane of said work piece, and the process which gives the electrode material which serves as an electrode from the principal plane side of said mask are included. Said mask Two or more membrane formation holes arranged in order to make said ingredient adhere to said work piece, The masking section which contacts the predetermined part of said work piece and covers the predetermined part of said work piece, And the electrode formation approach of electronic parts which both ends are fixed and arranged so that between the ***** aforementioned membrane formation holes may be straddled near said membrane formation hole, and contains the flexible section of the shape of a beam encastre which absorbs heat deformation of said masking section.

[Claim 2] Said flexible section is the electrode formation approach of electronic parts according to claim 1 constituted by preparing an outlet port near said membrane formation hole.

[Claim 3] Said flexible section is the electrode formation approach of electronic parts according to claim 1 constituted by preparing a notch near said membrane formation hole.

[Claim 4] Said flexible section is the electrode formation approach of electronic parts according to claim 1 to 3 arranged by the symmetry to the center line of said masking section between the ***** aforementioned membrane formation holes.

[Claim 5] Said flexible section is arranged at the both sides of said masking section. The die length of said flexible section A (mm), The overall length of C (mm) and said masking section for the width of face of said flexible section 2L (mm), If the coefficient of thermal expansion of the ingredient of h (mm) and said mask is set [the width of face of said masking section / the temperature gradient of the maximum temperature of 2B (mm) and said masking section, and the temperature of the periphery of said masking section] to alpha (1/-degree C) for the thickness of deltaT (degree C) and

$$1/2 L^3 C^3 \alpha \Delta T$$

$$3 \geq \frac{\pi^2 h^2 \{ L C^3 (1 + \alpha \Delta T) + A^3 B \}}{\text{said mask,}}$$

The electrode formation approach of electronic parts according to claim 1 to 4 to satisfy.

[Claim 6] Said flexible section is arranged at one end of said masking section. The die length of the flexible section A (mm), The overall length of C (mm) and said masking section for the width of face of said flexible section 2L (mm), If the coefficient of thermal expansion of the ingredient of h (mm) and said mask is set [the width of face of said masking section / the temperature gradient of the maximum temperature of 2B (mm) and said masking section, and the temperature around said masking section] to alpha (1/-degree C) for the thickness of deltaT (degree C) and said mask,

$$2/4 L^3 C^3 \alpha \Delta T$$

$$3 \geq \frac{\pi^2 h^2 \{ 2 L C^3 (1 + \alpha \Delta T) + A^3 B \}}{}$$

The electrode formation approach of electronic parts according to claim 1 to 4 to satisfy.

[Claim 7] It is electrode formation equipment of the electronic parts which make the ingredient used as an electrode adhere to a work piece using a mask. Said mask Two or more membrane formation holes arranged in order to make said ingredient adhere to said work piece, The masking section which contacts the predetermined part of said work piece and covers the predetermined part of said work piece, And electrode formation equipment of electronic parts which both ends are fixed and arranged so that between the ***** aforementioned membrane formation holes may be straddled near said membrane formation hole, and contains the flexible section of the shape of a beam encastre which absorbs heat deformation of said masking section.

[Claim 8] Said flexible section is electrode formation equipment of electronic parts according to claim 7 constituted by preparing an outlet port near said membrane formation hole.

[Claim 9] Said flexible section is electrode formation equipment of electronic parts according to claim 7 constituted by preparing a notch near said membrane formation hole.

[Claim 10] Said flexible section is electrode formation equipment of electronic parts according to claim 7 to 9 arranged by the symmetry to the center line of said masking section between the ***** aforementioned membrane formation holes.

[Claim 11] Said flexible section is arranged at the both sides of said masking section. The die length of said flexible section A (mm), The overall length of C (mm) and said masking section for the width of face of said flexible section 2L (mm), If the coefficient of thermal expansion of the ingredient of h (mm) and said mask is set [the width of face of said masking section / the temperature gradient of the maximum temperature of 2B (mm) and said masking section, and the temperature of the periphery of said masking section] to alpha (1/degree C) for the thickness of deltaT (degree C) and

$$12L^3C^3\alpha\Delta T$$

$$3 \geq \frac{\pi^2 h^2 \{LC^3 (1 + \alpha\Delta T) + A^3 B\}}{said\ mask,}$$

Electrode formation equipment of electronic parts according to claim 7 to 10 to satisfy.

[Claim 12] Said flexible section is arranged at one side of said masking section. The die length of said flexible section A (mm), The overall length of C (mm) and said masking section for the width of face of said flexible section 2L (mm), If the coefficient of thermal expansion of the ingredient of h (mm) and said mask is set [the width of face of said masking section / the temperature gradient of the maximum temperature of 2B (mm) and said masking section, and the temperature of the periphery of said masking section] to alpha (1/degree C) for the thickness of deltaT (degree C) and

$$24L^3C^3\alpha\Delta T$$

$$3 \geq \frac{\pi^2 h^2 \{2LC^3 (1 + \alpha\Delta T) + A^3 B\}}{said\ mask,}$$

Electrode formation equipment of electronic parts according to claim 7 to 10 to satisfy.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the electrode formation equipment which an electrode is formed, for example, is used for a substrate at the electrode formation approach of electronic parts, such as a radiator and a resonator, and it especially about the electrode formation equipment used for the electrode formation approach of electronic parts, and it.

[0002]

[Description of the Prior Art] Drawing 9 is the top view showing an example of the conventional mask for vacuum evaporationo used as the background of this invention. This mask 1 for vacuum evaporationo contains the rectangular metal plate 2. Two or more openings 3 are formed in the metal plate 2 at the position. These openings 3, ..., 3 are divided by two or more batch section 1b which has a function as the 1st masking section, and those partition section 1b is connected to periphery 1a which has a function as the 2nd masking section.

[0003] Since the width of face is thin, batch section 1b which divides opening 3 with such a mask 1 for vacuum evaporationo has the small heat release by heat conduction at the time of vacuum evaporationo. Moreover, since periphery 1a becomes an attaching part for carrying this mask 1 for vacuum evaporationo, heat is usually emitted from a part for that attaching part. Therefore, the temperature of batch section 1b becomes higher than the temperature of periphery 1a, and the amount of thermal expansion of batch section 1b becomes larger than the amount of thermal expansion of periphery 1a. And since the rigidity of batch section 1b is smaller than the rigidity of periphery 1a, batch section 1b carries out heat deformation, and a clearance produces it between batch section 1b and the work piece formed as a substrate. Therefore, the electrode material used as an electrode layer enters the clearance. In this case, a defect part and an electrode pattern (common name: dotage) poor [so-called] will be generated to some electrode patterns.

[0004] Then, as it is shown in drawing 10 if it puts in another way in order to ease this poor electrode pattern in order to ease heat deformation of batch section 1b resulting from the temperature gradient of batch section 1b and its periphery 1a for example, the mask 1 for vacuum evaporationo which formed infeed 4 in the perimeter of periphery 1a is proposed. This mask for vacuum evaporationo serves as a background of this invention, and is indicated by JP,61-130480,A. This mask 1 for vacuum evaporationo is formed in ** to which two or more infeeds 4 reach [from opening 3] the edge of the metal plate 2, and meet especially the straight line of the metal plate 2 which passes along a core mostly compared with the conventional example of drawing 9 . With the mask 1 for vacuum evaporationo shown in drawing 10 , since the difference of the amount of thermal expansion of batch section 1b and periphery 1a is absorbed by infeed 4 at the time of vacuum evaporationo, compared with the mask 1 for vacuum evaporationo shown in drawing 9 , a poor electrode pattern can be made to some extent small.

[0005] Drawing 11 and drawing 12 are the top views showing an example of the conventional sputtering mask which is indicated by JP,63-73350,U and serves as a background of this invention further. The sputtering mask 1 of drawing 12 contains the rectangle frame-like mask frame 5. In the center of the mask frame 5, the mask section 6 of a circle configuration which has the spatter holes 6a, ..., 6a of two or more rectangles is arranged. The mask section 6 is supported by the support sections 7a, 7b, 7c, and 7d which are prolonged to the mask section 6 from an each sides [of the

mask frame 5 / 5a, 5b, 5c, and 5d] center, and are connected with the mask section 6. It becomes the support sections 7a-7d from the notch of the shape for example, of a semicircle, and misses in them, and Slots 8a-8d are formed in them. Moreover, it supports in the mask frame 5 with each sides 5a-5d of the mask frame 5, and four dummy holes 9 are formed in it according to a collaboration operation with Sections 7a-7d and the mask section 6. On the other hand, the support sections 7e, 7f, 7g, and 7h which the mask section 6 is formed in the shape of a rectangle compared with the sputtering mask 1 of drawing 11 , miss the sputtering mask 1 of drawing 12 in the support section which supports the mask section 6 especially, and have not formed Slots 8a-8d are arranged further. With the sputtering mask 1 shown in drawing 11 and drawing 12 , since the expansion force can be missed and it can absorb by Slots 8a-8d when the mask section 6 carries out thermal expansion and spreads at the time of sputtering, a poor electrode pattern can be made small.

[0006]

[Problem(s) to be Solved by the Invention] However, with the structure of the mask 1 for vacuum evaporationo of drawing 10 currently indicated by JP,61-130480,A, since an electrode material enters also into infeed 4 part at the time of vacuum evaporationo, the electrode pattern for which it asks cannot be obtained correctly. Moreover, since the configuration of opening 3 deforms in connection with deformation of the metal plate 2 as the two-dot chain line of drawing 10 shows when the compressive stress by the thermal expansion at the time of vacuum evaporationo is large, this and the electrode pattern for which it asks cannot be obtained correctly.

[0007] On the other hand, with the sputtering mask 1 of drawing 11 currently indicated by JP,63-73350,U, since it misses in the narrow support sections 7a-7d of the width method which supports the mask section 6 and Slots 8a-8d are formed, the mechanical strength of the support sections 7a-7d, as a result the mask section 6 becomes weak, and there is a possibility that the mask section 6 cannot be supported correctly. Furthermore, the handling by the mask itself will also become difficult.

[0008] Moreover, with the sputtering mask 1 of drawing 12 , since there are the support sections 7e-7h which miss and do not have a slot, the effectiveness of absorbing the compressive stress by the thermal expansion at the time of sputtering cannot be attained. Therefore, the electrode pattern which asks also for the sputtering mask 1 of drawing 12 currently indicated by JP,63-73350,U cannot be obtained correctly.

[0009] So, it is offering the electrode formation equipment which the main purpose of this invention uses for the electrode formation approach of electronic parts with few falls on the strength, and it there being very few poor electrode patterns resulting from heat deformation.

[0010]

[Means for Solving the Problem] The process for which invention according to claim 1 is the electrode formation approach of electronic parts of making the ingredient used as an electrode adhering to a work piece using a mask, and a work piece is prepared, The process which arranges a mask on the principal plane of a work piece, and the process which gives the electrode material which serves as an electrode from the principal plane side of a mask are included. A mask Two or more membrane formation holes arranged in order to make an ingredient adhere to a work piece, and the masking section which contacts the predetermined part of a work piece and covers the predetermined part of said work piece, It is the electrode formation approach of electronic parts which both ends are fixed and arranged so that between ***** membrane formation holes may be straddled near the membrane formation hole, and contains the flexible section of the shape of a beam encastre which absorbs heat deformation of the masking section. Invention according to claim 2 is the electrode formation approach of electronic parts according to claim 1 constituted when the flexible section prepares an outlet port near the membrane formation hole. Invention according to claim 3 is the electrode formation approach of electronic parts according to claim 1 constituted when the flexible section prepares a notch near the membrane formation hole. Invention according to claim 4 is the electrode formation approach of electronic parts according to claim 1 to 3 that the flexible section is arranged by the symmetry to the center line of the masking section between ***** membrane formation holes. As for invention according to claim 5, the flexible section is arranged at the both sides of the masking section. The overall length of C (mm) and the masking section for the width of face of A (mm) and the flexible section 2L (mm), [the die length of the flexible section] If the coefficient of thermal expansion of the ingredient of h (mm) and a mask is set [the width of face

of the masking section / the temperature gradient of the maximum temperature of 2B (mm) and the masking section, and the temperature of the periphery of the masking section] to alpha (1-/degree C) for the thickness of deltaT (degree C) and a mask,

$$12L^3C^3\alpha\Delta T$$

$3 \geq$

$$\pi^2 h^2 \{LC^3 (1 + \alpha\Delta T) + A^3 B\}$$

It is the electrode formation approach of electronic parts according to claim 1 to 4 to satisfy. As for invention according to claim 6, the flexible section is arranged at one end of the masking section. The overall length of C (mm) and the masking section for the width of face of A (mm) and the flexible section 2L (mm), [the die length of the flexible section] If the coefficient of thermal expansion of the ingredient of h (mm) and a mask is set [the width of face of the masking section / the temperature gradient of the maximum temperature of 2B (mm) and the masking section, and the temperature around the masking section] to alpha (1-/degree C) for the thickness of deltaT (degree

$$24L^3C^3\alpha\Delta T$$

$3 \geq$

$$\pi^2 h^2 \{2LC^3 (1 + \alpha\Delta T) + A^3 B\}$$

C) and a mask,

It is the electrode formation approach of electronic parts according to claim 1 to 4 to satisfy. Invention according to claim 7 is electrode formation equipment of the electronic parts which make the ingredient used as an electrode adhere to a work piece using a mask. A mask Two or more membrane formation holes arranged in order to make an ingredient adhere to a work piece, and the masking section which contacts the predetermined part of a work piece and covers the predetermined part of said work piece, It is electrode formation equipment of electronic parts which both ends are fixed and arranged so that between ***** membrane formation holes may be straddled near the membrane formation hole, and contains the flexible section of the shape of a beam encastre which absorbs heat deformation of the masking section. Invention according to claim 8 is electrode formation equipment of electronic parts according to claim 7 constituted when the flexible section prepares an outlet port near the membrane formation hole. Invention according to claim 9 is electrode formation equipment of electronic parts according to claim 7 constituted when the flexible section prepares a notch near the membrane formation hole. Invention according to claim 10 is electrode formation equipment of electronic parts according to claim 7 to 9 with which the flexible section is arranged by the symmetry to the center line of the masking section between ***** membrane formation holes. As for invention according to claim 11, the flexible section is arranged at the both sides of the masking section. The overall length of C (mm) and the masking section for the width of face of A (mm) and the flexible section 2L (mm), [the die length of the flexible section] If the coefficient of thermal expansion of the ingredient of h (mm) and a mask is set [the width of face of the masking section / the temperature gradient of the maximum temperature of 2B (mm) and the masking section, and the temperature of the periphery of the masking section] to alpha (1-/degree C) for the thickness of deltaT (degree C) and a mask,

$$12L^3C^3\alpha\Delta T$$

$3 \geq$

$$\pi^2 h^2 \{LC^3 (1 + \alpha\Delta T) + A^3 B\}$$

It is electrode formation equipment of electronic parts according to claim 7 to 10 to satisfy. As for invention according to claim 12, the flexible section is arranged at one side of the masking section. The overall length of C (mm) and the masking section for the width of face of A (mm) and the flexible section 2L (mm), [the die length of the flexible section] If the coefficient of thermal expansion of the ingredient of h (mm) and a mask is set [the width of face of the masking section / the temperature gradient of the maximum temperature of 2B (mm) and the masking section, and the temperature of the periphery of the masking section] to alpha (1-/degree C) for the thickness of

$$24L^3C^3 \alpha \Delta T$$

3 ≥

$$\pi^2 h^2 \{ 2LC^3 (1 + \alpha \Delta T) + A^3 B \}$$

deltaT (degree C) and a mask,

It is electrode formation equipment of electronic parts according to claim 7 to 10 to satisfy.

[0011]

[Function] In invention according to claim 1 to 12, the heat deformation produced with the thermal stress of masking circles resulting from the temperature gradient of the masking section and its periphery, i.e., the compressive stress by thermal expansion being restrained, is absorbed and eased, when the flexible section bends. Especially, in claim 2 and invention according to claim 8, when the flexible section bends in the direction of a recess hole, heat deformation of the masking section is absorbed. Moreover, in claim 3 and invention according to claim 9, when the flexible section bends in the direction of a notch, heat deformation of the masking section is absorbed. Moreover, in claim 5 and invention according to claim 11, the flexible section is arranged at the both sides of the masking section, and heat deformation of the masking section becomes still better by satisfying the formula shown by claim 5 and claim 11. Furthermore, in claim 6 and invention according to claim 12, the flexible section is arranged at one side of the masking section, and heat deformation of the masking section becomes still better by satisfying the formula shown by claim 6 and claim 12.

[0012]

[Effect of the Invention] According to invention according to claim 1 to 12, the buckling which is deformation of a direction perpendicular to the work-piece principal plane of the masking section is eased according to the above-mentioned operation, and adhesion with the predetermined part of the work piece covered by the masking section and the masking section is not spoiled. Therefore, an exact electrode pattern without a blot can be formed in the edge of an electrode pattern at a work piece. Furthermore, according to invention according to claim 1 to 12, as shown in the conventional example, the reinforcement of the mask itself does not become extremely low. That is, according to this invention, the electrode formation equipment which the poor electrode pattern resulting from heat deformation uses for the electrode formation approach of electronic parts with few falls on the strength and it very few is obtained.

[0013] The above-mentioned purpose of this invention, the other purposes, the description, and an advantage will become still clearer from detailed explanation of the gestalt of implementation of the following invention performed with reference to a drawing.

[0014]

[Embodiment of the Invention]

[Example] Drawing 1 is the perspective view showing one example of this invention, drawing 2 is that decomposition perspective view, and drawing 3 is a notching *** important section top view about that part. Explanation of this example explains the electrode formation equipment of the electronic parts of this invention first. The electrode formation equipment 10 of these electronic parts contains the rectangle tabular work holder 12. A work holder 12 has two or more rectangular maintenance holes 14, 14, ..., 14. These maintenance holes 14 are for holding work pieces W, W, ..., W, and are penetrated and established in an another side principal plane from the one side principal plane of a work holder 12. Although two or more maintenance holes 14 separate predetermined spacing in all directions [of a work holder 12] and are established in it, in drawing 1 and drawing 2, illustration of two or more maintenance holes 14, ..., 14 arranged in pars intermedia is omitting them.

[0015] The rectangle tabular membrane formation pattern masks 16 and 18 are arranged in an one side principal plane [of a work holder 12], and another side principal plane side as a mask, respectively. Since the membrane formation patterns 16 and 18 have the same structure, one membrane formation pattern mask 16 is explained. The membrane formation pattern mask 16 has two or more rectangular membrane formation holes 20, 20, ..., 20. These membrane formation holes 20 are for on the other hand forming the predetermined membrane formation pattern of work pieces W, W, ..., W in a principal plane, and are penetrated and prepared in an another side principal plane from the one side principal plane of the membrane formation pattern mask 16. In this example, 1 set of two membrane formation holes 20 and 20 arranged lining up side-by-side, for example are

extended and formed in the die-length direction of the membrane formation pattern mask 16. 1 set of two membrane formation holes 20 and 20 separate predetermined spacing in all directions [of the membrane formation pattern mask 16], and are prepared in it two or more sets. Although two or more membrane formation holes 20 separate predetermined spacing in all directions [of the membrane formation pattern mask 16] and are prepared in it, in drawing 1 and drawing 2, illustration of two or more membrane formation holes 20, ..., 20 arranged in pars intermedia is omitting them.

[0016] As shown in the membrane formation pattern mask 16 at drawing 3 and drawing 4, the 1st masking section 22 and the 2nd masking section 24 are formed in the perimeter of two or more membrane formation holes 20 and 20. In this case, the 1st masking section 22 is formed in one end and lateral stable ranking and hierarchy of the membrane formation holes 20 and 20 of the membrane formation hole 20 between the ends of the longitudinal direction of the membrane formation hole 20 of ***** another side. [of each class] Moreover, the 2nd masking section 24 is formed in one end and vertical list of the die-length direction of the membrane formation holes 20 and 20 of the membrane formation hole 20 between the ends of the die-length direction of the membrane formation hole 20 of ***** another side. [of each class]

[0017] It is constituted as the masking section in which the 1st masking section 22 has the masking function of Maine, and consists of this example as the masking section in which the 2nd masking section 24 has a factice's masking function.

[0018] Furthermore, it is near the 1st masking section 22, and 1 set of 1st outlet ports 26 and 26 are partially arranged in an end [of the die-length direction of the 1st masking section 22], and other end side by the membrane formation pattern mask 16 in this case, respectively. On the other hand, the 1st outlet port 26 and 26 of another side is arranged so that between the membrane formation hole 20 lining up side-by-side and 20 may be straddled, respectively. In this example, as especially shown, for example in drawing 4, the overall length of the 1st masking 22 is formed in 2L (mm), and that width of face is formed in 2B (mm). Moreover, from the 1st lateral end and lateral other end of the masking section 22, only the distance of A (mm) is prolonged in the longitudinal direction of the membrane formation holes 20 and 20, and outlet ports 26 and 26 project it, and are prepared, respectively. In addition, in this example, thickness [of the 1st masking section 22] h (mm) is formed similarly to the thickness of the membrane formation pattern masks 16 and 18, and the direction of overall-length 2L (mm) and width-of-face 2B (mm) of the 1st masking section 22 is greatly formed to that thickness h (mm).

[0019] In this example, since the 1st outlet port 26 and 26 is established in the both sides of the die-length direction of the 1st masking 22, between the outlet port 26 of both sides, and the 1st masking section 22, the so-called flexible sections 30 and 30 of the shape of a beam encastre to which those both ends of a long and slender rectangle are being fixed are formed. In this case, if the part in which only the distance of A (mm) was prolonged in the longitudinal direction of the membrane formation holes 20 and 20, and was projected and prepared in it from the 1st lateral end and lateral other end of the masking section 22 is made into the die length of the flexible sections 30 and 30, respectively, the die length of the flexible sections 30 and 30 will be formed in A (mm), and the width of face of the flexible sections 30 and 30 will be formed in C (mm). Moreover, the overall length of outlet ports 26 and 26 is formed in [a+b (mm)]. In this example, when distance from the end and the other end of X and the die-length direction of the 1st outlet port 26 and 26 to a medial axis X is set to a (mm) and b (mm) for the medial axis of the 1st masking section 22, respectively, it is formed in a=b. If this is put in another way, as for the flexible sections 30 and 30, the die length is formed equally [right and left] focusing on the medial axis X. That is, it is arranged by the symmetry to the center line of the cross direction of the ***** membrane formation hole 20 and the 1st masking section 22 between 20.

[0020] Furthermore, it is near the 2nd masking section 24, and 1 set of 2nd outlet ports 28 and 28 are partially arranged in an end [of the die-length direction of the 2nd masking section 24], and other end side by the membrane formation pattern mask 16 in this case, respectively. On the other hand, the 2nd outlet port 28 and 28 of another side is arranged, respectively so that between the membrane formation hole 20 of a vertical list and 20 may be straddled.

[0021] Similarly, the membrane formation pattern mask 18 is arranged in the another side principal

plane side of a work holder 12. In addition, in this example, a work holder 12 and the membrane formation pattern masks 16 and 18 are formed in the almost same magnitude, and tooling holes (not shown) are prepared in the location which corresponds mutually, respectively.

[0022] A work holder 12 is in the condition pinched between two membrane formation pattern masks 16 and 18, and the mask electrode holder (not shown) which has a gage pin is equipped with it. In this case, one by one, the membrane formation pattern mask 18, a work holder 12, and the membrane formation pattern mask 16 are inserted in the gage pin of a mask electrode holder (not shown), and a mask electrode holder (not shown) is equipped with them.

[0023] Next, the electrode formation approach of the electronic parts using the electrode formation equipment 10 of the electronic parts containing the above-mentioned work holder 12 and the membrane formation pattern masks 16 and 18 is explained. First, two or more rectangle tabular work pieces W used as a substrate are prepared. Electrostrictive ceramics etc. is used for these work pieces W. Moreover, a work holder 12 and the membrane formation pattern masks 16 and 18 are prepared.

[0024] And two or more work pieces W are inserted in the maintenance hole 14 of a work holder 12, and are held. Moreover, the membrane formation pattern masks 16 and 18 are arranged at a front-face [of a work holder 12], and rear-face side. Furthermore, where the work holder 12 which held the work piece W between the membrane formation pattern mask 16 and 18 is pinched, a mask electrode holder (not shown) is equipped with those members 16, 12, and 18. A work piece W is positioned by it at a position.

[0025] And it is in the condition which set a work holder 12 and the membrane formation pattern masks 16 and 18 to the mask electrode holder (not shown), for example, membrane formation processing is performed to the front face and rear face of a work piece W by sputtering, vacuum evaporation, and the other membrane formation approaches. Therefore, in the front face and rear face of a work piece W, an electrode material adheres to the part exposed through the membrane formation hole 20 of the membrane formation pattern masks 16 and 18, respectively. Moreover, since the electrode garbage of the front face of a work piece W and a rear face is covered by the part 22 except the membrane formation hole 20 of the membrane formation pattern masks 16 and 18, i.e., the 1st masking section, and the 2nd masking section 24, an electrode material does not adhere.

Therefore, the desired membrane formation pattern used as an electrode is formed in the front face and rear face of a work piece W, respectively.

[0026] Especially in this example, by arranging outlet ports 26 and 26 in the both sides of the die-length direction of the 1st masking section 22 of the membrane formation pattern masks 16 and 18. Since the so-called flexible sections 30 and 30 of the shape of a beam encastre which the both ends are fixed to the both sides of the die-length direction of the 1st masking section 22, and serves as the fixed end are formed. Heat deformation of the thermal stress 22 in the 1st masking section 22 generated at the time of membrane formation processing, i.e., the 1st masking section resulting from the temperature gradient of the 1st masking section 22 and periphery, can be absorbed by the flexible sections 30 and 30, and it can ease. In this case, as the 1st masking section 22 is connected to that periphery 24, i.e., the 2nd masking section, through the flexible sections 30 and 30, for example, it is shown in drawing 5, when the flexible sections 30 and 30 bend in an outlet port 26 and the 26 directions, the relaxation effect that heat deformation of the 1st masking section 22 can be absorbed, and it can ease is obtained.

[0027] When the artificer of the invention in this application examines an above-mentioned relaxation effect wholeheartedly, then, by the theoretical formula and the FEM simulation The relation with the compressive stress sigma (kgf/mm²) which remains without the ability easing in parameters, such as a configuration of the flexible sections 30 and 30, and an ingredient, and the 1st masking section 22 As shown in drawing 4, by for example, the case where the flexible beam-encastre-like sections 30 and 30 are arranged in the both sides of the die-length direction of the 1st masking section 22. The width of face of A (mm) and the masking section 22 of the above 1st for the die length of the above-mentioned flexible sections 30 and 30 2B (mm), The die length of C (mm) and the masking section 22 of the above 1st for the width of face of the above-mentioned flexible sections 30 and 30 2L (mm), The temperature gradient of the maximum temperature of the masking section 22 of the above 1st, and the temperature of the periphery of the masking section 22 of the above 1st deltaT (degree C), It turned out that the thickness of the masking section 22 of the above

1st can be expressed in general with the following [formula 1] if the modulus of direct elasticity of alpha (1/-degree C) and the masking section 22 of the above 1st is set to E (kgf/mm²) for the coefficient of thermal expansion of the ingredient of h (mm) and the masking section 22 of the above 1st.

[0028]

$$\sigma = \frac{E L C^3 \alpha \Delta T}{L C^3 (1 + \alpha \Delta T) + A^3 B} \quad \dots \text{[式1]}$$

[0029] On the other hand, if the configuration of the 1st masking section 22 is regarded as a long column with a rectangular cross section, compressive-stress σ_{k} (kgf/mm²) from which this 1st masking section 22 starts a buckling, and begins to produce deformation will become the following [formula 2] from Euler's equation. However, the both ends of the die-length direction of the 1st masking section 22 are assumed to be the fixed end in this case.

[0030]

$$\sigma_k = \frac{\pi^2 E h^2}{12 L^2} \quad \dots \text{[式2]}$$

[0031] A ratio [the artificer of the invention in this application / σ/σ_{k}] with compressive-stress σ_{k} (kgf/mm²) from which the compressive stress σ (kgf/mm²) and the 1st masking section 22 which remain without the ability easing in the 1st masking section 22 start a buckling, and begin to produce deformation, i.e., it is. It was assumed that the existence of a poor electrode pattern (common name: dotage) was determined. Namely, σ/σ_{k} It was assumed that it became the following [formula 3].

[0032]

$$\frac{\sigma}{\sigma_k} = \frac{12 L^3 C^3 \alpha \Delta T}{\pi^2 h^2 \{ L C^3 (1 + \alpha \Delta T) + A^3 B \}} \quad \dots \text{[式3]}$$

[0033] Then, σ/σ_{k} The relation between a ratio and the existence of a poor electrode pattern (common name: dotage) was investigated by the following examples of an experiment.

[Example of an experiment] In this example of an experiment, consider as the thickness $h=0.3$ (mm) of the membrane formation pattern mask 16 (18), and it sets to drawing 4 further. It considered as $L=14.7$ (mm), $C=0.3$ (mm), $\alpha=18 \times 10^{-6}$ (1/-degree C) (ingredient: 304 about SUS), and $\Delta T=180$ degree C (fruit side value), and further, the dimension of A and B was set up suitably and the membrane formation pattern mask was made as an experiment. And membrane formation processing was performed to the work piece W using the membrane formation pattern mask. The experimental result is shown in the graph of drawing 6. The continuous line and broken line in drawing 6 express the count result of the above [a formula 3] by making die-length [of the above-mentioned flexible sections 30 and 30] A (mm) into a parameter. In this case, it is shown that the poor electrode pattern (common name: dotage) generated the plotting point of NG-data, and the plotting point of G-data shows that a poor electrode pattern (common name: dotage) is not generated.

[0034] It is $3.0 >= \sigma/\sigma_{k}$ so that clearly from the experimental result of drawing 6. When relation was satisfied, it was proved that a poor electrode pattern (common name: dotage) was not generated. In this case, if the configuration and ingredient of the membrane formation pattern masks 16 and 18 which have the 1st masking section 22, outlet ports 26 and 26, and flexible branches 30 and 30 are designed so that the value of the above [a formula 3] may become 3.0 or less, the poor electrode pattern at the time of membrane formation processing (common name: dotage) can be prevented. That is, if the membrane formation pattern mask with which are satisfied of the above [a formula 3] is used, when the flexible sections 30 and 30 bend in an outlet port 26 and the 26 directions, heat deformation of the 1st masking branch 22 resulting from the temperature gradient of

the 1st masking section 22 and the periphery at the time of membrane formation processing absorbs heat deformation of the 1st masking section 22, and can be eased.

[0035] Therefore, in this example, it can prevent the part except the membrane formation hole 20 of a work piece W and the membrane formation pattern masks 16 and 18, and that a clearance occurs between the 1st masking section 22 especially. Therefore, in this example, the poor electrode pattern (common name: dotage) produced when an electrode material enters between a work piece W and said clearance can be prevented. That is, in the above-mentioned example, an electrode pattern can be correctly formed in a work piece W, and a pattern edge also becomes clear. So, if the substrate which has the electrode formed by the electrode formation approach using the electrode formation equipment of this example is used, electrical characteristics are stable and can produce the electronic parts which were rich in dependability.

[0036] Although the flexible sections 30 and 30 were arranged in the both sides of the die-length direction of the 1st masking section 22 in the above-mentioned example, when the flexible section 30 is arranged only in one side of the die-length direction of the 1st masking section 22, 2L, then since it is good, it is sigma/sigmak about L of the above [a formula 1]. It is assumed that it becomes the following [formula 4].

[0037]

$$\frac{\sigma}{\sigma_k} = \frac{24L^3C^3\alpha\Delta T}{\pi^2h^2\{2LC^3(1+\alpha\Delta T)+A^3B\}} \dots \text{[式4]}$$

[0038] Also in this case, it is $3.0 \geq \sigma_k$, in order to absorb heat deformation of the 1st masking section 22 and to ease. It is desirable to satisfy relation.

[0039] Drawing 7 is the important section top view showing other examples of this invention. This example does not have the especially uniform width of face of the 1st masking section compared with the example shown in drawing 1 - drawing 4, etc. That is, in the example shown in drawing 7, compared with the 1st masking branch 22 shown in drawing 4 etc., the rectangular lobes 34 and 34 are formed in the pars intermedia of the die-length direction of the 1st masking section 32, and the width method of the 1st masking section 32 is not fixed. In this case, what is necessary is to perform stress count of the above [a formula 3] and just to design a membrane formation pattern mask safely more by setting the dimension of the smallest part of the width of face of the 1st masking section 32 as width-of-face 2B (mm) of the masking section.

[0040] Drawing 8 is the important section top view showing the example of further others of this invention. Compared with the example shown in drawing 1 - drawing 4, etc., especially, two or more 1st masking sections adjoin, and this example is formed. That is, in the example shown in drawing 8, the 1st two masking section 36a and 36b is adjoined and arranged in the longitudinal direction through other 1st outlet port 38 [the 1st masking branch 22 arranged by independent / which is shown in drawing 4 etc.]. Therefore, in the example shown in drawing 8, the independent flexible section 30 cannot be formed in the both sides of the die-length direction of the 1st two masking section 36a and 36b, respectively. Therefore, in the example shown in drawing 8, it has composition which shares the one flexible section 30 in the both sides of the die-length direction of the 1st two masking section 36a and 36b, respectively. In this case, the dimension (mm) of the masking width of face of the 1st masking section 36a and 36b is 2B-2B0. It is set up by carrying out and stress count of the above [a formula 3] is performed. In addition, what is necessary is just to design a membrane formation pattern mask in the example shown in drawing 8, by setting up the width method of the masking section by the same approach, and performing stress count of the above [a formula 3], even when formed or more in three, for example although the masking section was formed in the 1st two masking section 36a and 36b.

[0041] In addition, although the flexible section was formed by arranging an outlet port near the membrane formation hole in each above-mentioned example For example, it changes into the 1st outlet port 26 and 2nd outlet port 28 of drawing 3 and drawing 4. For example, you may make it form the flexible section, respectively by applying near the membrane formation holes 20 and 20 from the end of the die-length direction of the membrane formation pattern mask 16 (18), and the cross direction, and arranging a notch. Moreover, although the membrane formation hole 20

prepared in the membrane formation pattern masks 16 and 18 was formed in the rectangle in each above-mentioned example, it is mere instantiation and the configuration of a membrane formation hole may be changed into other configurations at arbitration according to the configuration of the electrode pattern for which it asks. Moreover, according to the configuration of a work piece W, the configuration of a work holder 12 can also be changed suitably.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the perspective view showing one example of this invention.

[Drawing 2] It is the decomposition perspective view showing one example of this invention.

[Drawing 3] It is a notching **** important section top view about the part which shows one example of this invention.

[Drawing 4] It is the important section top view showing one example of this invention.

[Drawing 5] It is the illustration Fig. showing an operation of the flexible section in the example of drawing 1 - drawing 4 , and (A) shows the condition before heat deformation and shows the time of (B) heat deformation.

[Drawing 6] It is the graph which shows the relation between the existence of generating of a poor electrode pattern, and a stress ratio.

[Drawing 7] It is the important section top view showing other examples of this invention.

[Drawing 8] It is the important section top view showing the example of further others of this invention.

[Drawing 9] It is the top view showing an example of the conventional mask for vacuum evaporationo used as the background of this invention.

[Drawing 10] It is the top view showing other examples of the conventional mask for vacuum evaporationo used as the background of this invention.

[Drawing 11] It is the top view showing an example of the conventional sputtering mask used as the background of this invention.

[Drawing 12] It is the top view showing other examples of the conventional sputtering mask used as the background of this invention.

[Description of Notations]

10 Electrode Formation Equipment of Electronic Parts

12 Work Holder

14 Maintenance Hole

16 18 Membrane formation pattern mask

20 Membrane Formation Hole

22 1st Masking Section

24 2nd Masking Section

26 1st Outlet Port

28 2nd Outlet Port

30 Flexible Section

32 Other 1st Masking Section

34 Lobe

36a, 36b The 1st masking section of further others

38 Other 1st Outlet Port

A The die length of the flexible section (mm)

2B Width of face of the 1st masking section (mm)

C Width of face of the flexible section (mm)

2L The overall length of the 1st masking section (mm)

h Thickness of the 1st masking section (mm)

deltaT Temperature gradient of the maximum temperature and periphery of the 1st masking section at the time of membrane formation processing

alpha Coefficient of thermal expansion of the 1st masking section (1-/degree C)

E Modulus of direct elasticity of the 1st masking section (kgf/mm²)

sigma Compressive stress which remains without the ability easing in the 1st masking section 22 (kgf/mm²)

sigmak Compressive stress from which the 1st masking section 22 starts a buckling, and begins to produce deformation (kgf/mm²)

[Translation done.]

* NOTICES *

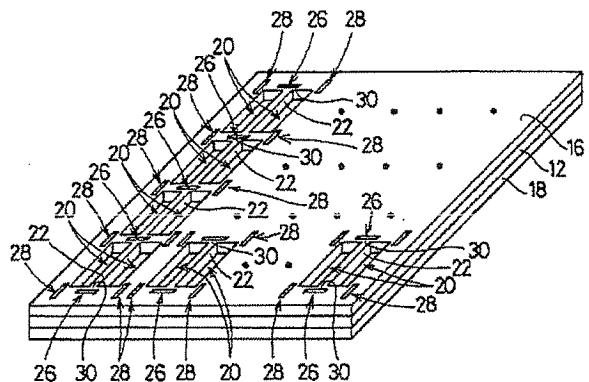
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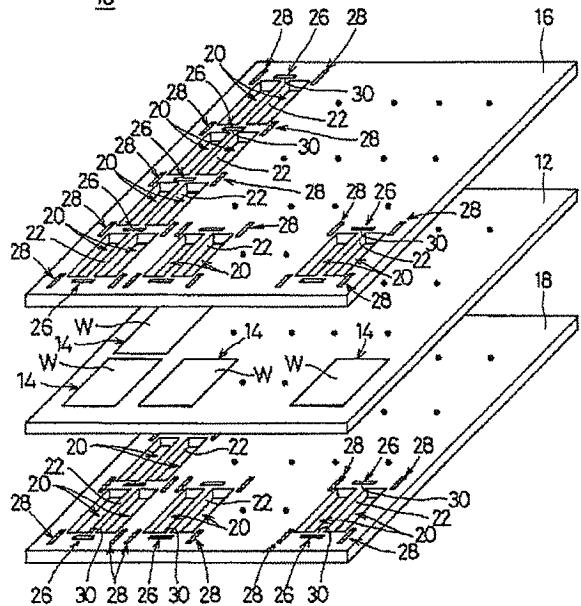
DRAWINGS

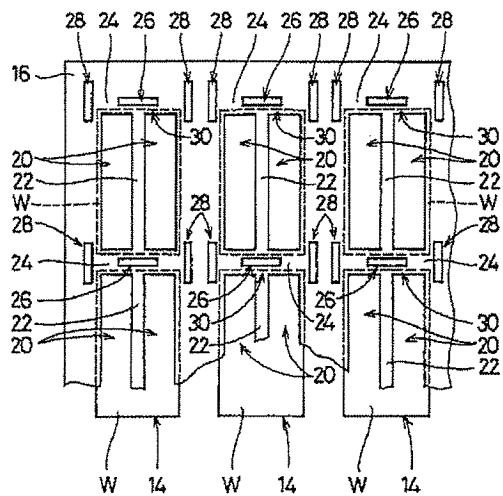
[Drawing 1]

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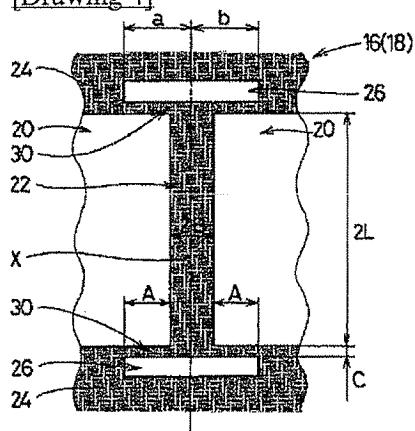
**[Drawing 2]**

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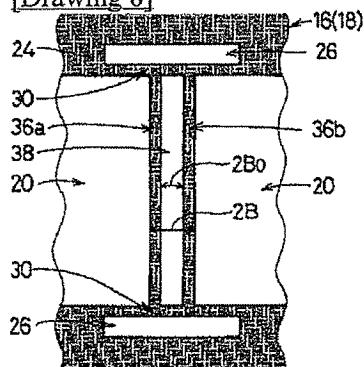
**[Drawing 3]**



[Drawing 4]

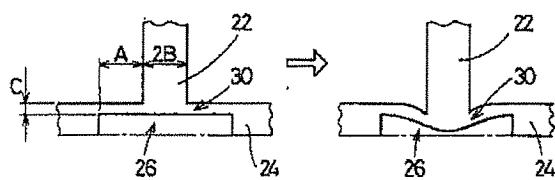


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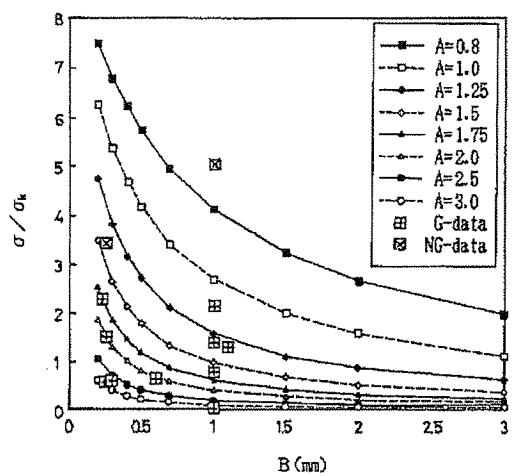


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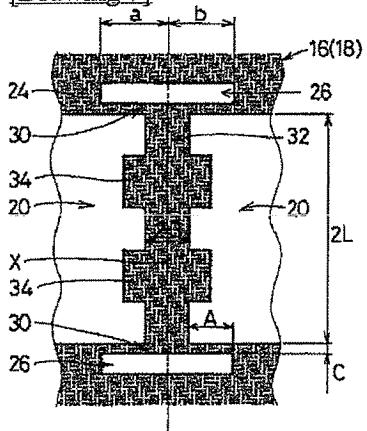
(A) (B)



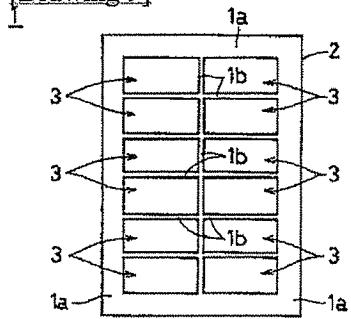
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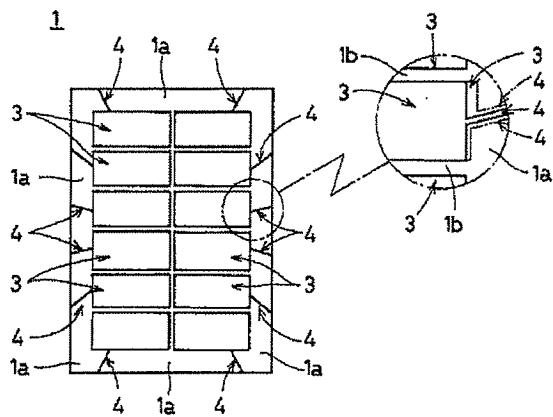
[Drawing 7]



[Drawing 9]

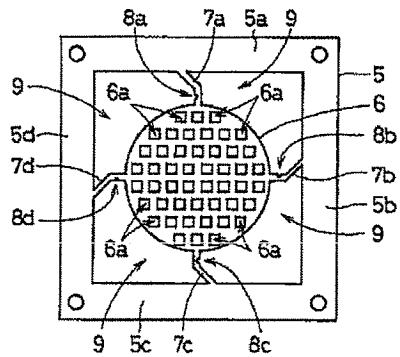


[Drawing 10]



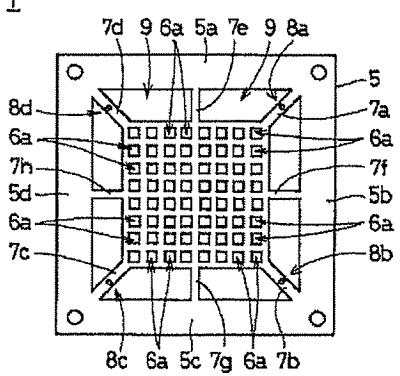
[Drawing 11]

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[Drawing 12]

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[Translation done.]